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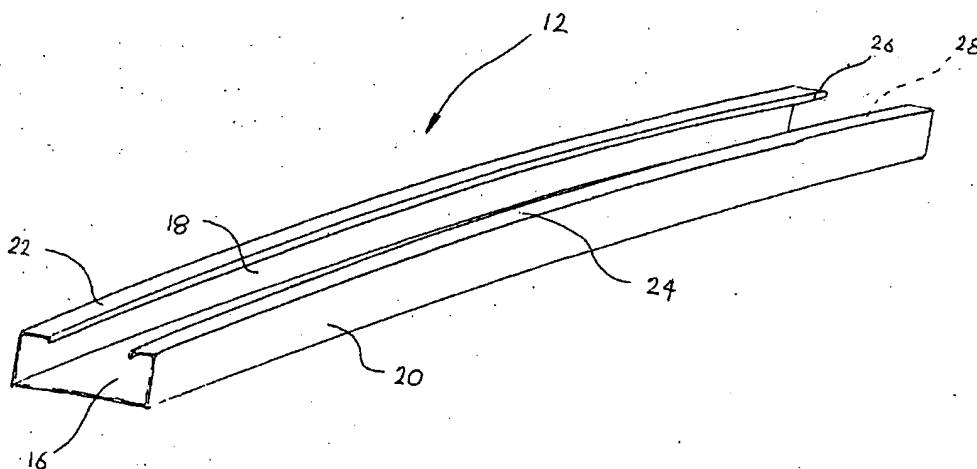
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- (71) Applicant (*for all designated States except US*): BHP STEEL (JLA) PTY LTD [AU/AU]; 1 York Street, Sydney, New South Wales 2000 (AU).
- (72) Inventor; and
- (75) Inventor/Applicant (*for US only*): SECCOMBE, Campbell, John [AU/AU]; 141 Pentecost Avenue, TURRAMURRA, New South Wales 2074 (AU).
- Published:
— with international search report
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METAL DECKING



(57) Abstract: The present invention relates generally to metal decking 10 including a pair of adjacent metal decking members 12 and 14 located alongside one another. The adjacent metal decking members 12 and 14 are of an identical cross-sectional shape being elongate and of a C-section profile. The C-section metal decking member 12 includes a web 16 and a pair of opposing flanges 18 and 20, respectively. The web 16 of the metal decking member 12 is longitudinally pre-cambered inwardly of the metal decking member 12. The metal decking member 12 which ordinarily in a concrete slab (not shown) is thus capable of spanning an increased distance unsupported.

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METAL DECKING

FIELD OF THE INVENTION

5 The present invention relates generally to metal decking and a method of forming metal decking. The invention relates particularly though not exclusively to metal decking for concrete clad roofing or flooring.

10 SUMMARY OF THE INVENTION

 According to one aspect of the present invention there is provided a metal decking member being elongate and of a C-section profile including a web and a pair of opposing flanges, the web being longitudinally precambered
15 inwardly of the metal decking member.

 Preferably the web together with the opposing flanges are longitudinally precambered.

20 According to another aspect of the present invention there is provided a method of forming a metal decking member being elongate and of a C-section profile including a web and a pair of opposing flanges, said method involving roll forming transversely oriented corrugations
25 in at least part of the web whereby the web is longitudinally precambered inwardly of the metal decking member.

 Preferably the transverse corrugations are cold roll
30 formed in the web. More preferably the transverse corrugations are relatively light.

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It has been found that longitudinal precambering of the web is effective in increasing the unsupported span of the metal decking member.

5 Preferably the longitudinal precamber is up to about 2% measured as the maximum longitudinal offset of the web from a substantially flat plane and expressed as a percentage relative to the length of the web. More preferably the longitudinal precamber is between about 10 0.4% to 1%. In one embodiment this equates to a precamber of between about 20 to 50 mm for an unsupported span of 5 metres.

 Preferably the web in transverse section is 15 precambered inwardly of the metal decking member. More preferably the transverse pre-camber is up to about 5% measured as the maximum offset of the web from a substantially flat plane and expressed as a percentage relative to the width of the web. Still more preferably 20 the transverse pre-camber is between about 1% to 4%.

 According to a further aspect of the present invention there is provided a metal decking member being elongate and of a C-section profile including a web and a 25 pair of opposing flanges, the web in transverse section being precambered inwardly of the metal decking.

 It has been found that precambering of the web is effective in increasing the unsupported span of the metal 30 decking member. Generally the metal decking member is clad or embedded in a concrete slab.

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Preferably the transverse precamber is up to about 5% measured as the maximum offset of the web from a substantially flat plane and expressed as a percentage relative to the width of the web. More preferably the
5 transverse precamber is between about 1% to 4%.

Preferably the pair of opposing flanges are disposed symmetrically either side of an imaginary longitudinal axis of the metal decking member. More preferably the C-
10 section profile of the metal decking member is substantially symmetrical.

Preferably a free edge portion of the C-section metal decking member includes a lip return disposed parallel to
15 the corresponding flange.

Preferably the flanges each include a longitudinally extending rib. More preferably the ribs are shaped complementary to and aligned with one another, one of the
20 ribs protruding outwardly and the other of said ribs protruding inwardly whereby adjacent ribs of adjacent decking members nest within one another.

Generally the metal decking member is one of a
25 plurality of metal decking members arranged alongside one another to together form metal decking.

Preferably adjacent of the plurality of decking members are secured together via fixing means. More
30 preferably said fixing means includes one or more fasteners designed to engage adjacent flanges of adjacent decking members. Alternatively said fixing means includes

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a resilient clip configured to releasably engage free edge portions of adjacent flanges of adjacent decking members.

Preferably the plurality of decking members are clad
5 or embedded in a concrete slab.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to facilitate a better understanding of the nature of the present invention a preferred embodiment of
10 metal decking and its method of fabrication will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a sectional view of one embodiment of metal decking according to the invention;

15 Figure 2 is a perspective view of another embodiment of a metal decking member according to the invention; and

Figure 3 is a sectional view of alternative fixing means of the metal decking.

20 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in Figure 1 there is metal decking 10 including a pair of adjacent metal decking members 12 and 14 located alongside one another. The metal decking 10 is designed to be embedded or clad in a concrete slab so as
25 to form a roof or floor.

The adjacent metal decking members such as 12 and 14 are of an identical cross-sectional shape being elongate and of a C-section profile. The C-section metal decking
30 member 12 includes a web 16 and a pair of opposing flanges 18 and 20, respectively. The metal decking such as 12 is of the C-section profile wherein opposing free edge portions 22 and 24 of the respective flanges 18 and 20 are

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turned inwardly. Additionally, each of the free edge portions 22 and 24 includes a respective lip return 26 and 28 which is disposed generally parallel to the corresponding flange 18 or 20. The metal decking members such as 12 and 14 are thus in cross-section of a substantially symmetrical configuration.

As shown in Figure 2 the web 16 of the metal decking member 12 is longitudinally pre-cambered inwardly of the metal decking member 12. The metal decking member 12 is of the kind illustrated in Figure 1 but without the longitudinally extending ribs. The metal decking member which ordinarily is embedded in a concrete slab (not shown) is thus capable of spanning an increased distance unsupported. The precamber of the web 16 is in this example about 0.6% measured as the maximum longitudinal offset of the web from a substantially flat plane and expressed as a percentage relative to the length of the web 16. It is understood that the longitudinally precambered web 16 is at least partly deflected toward the flat plane under the significant weight of the concrete slab. Advantageously, this longitudinal precamber provides minimal deflection of the metal decking member 12 which spans increased distances. In this embodiment the metal decking member 12 spans up to about 5 metres unsupported and includes a longitudinal precamber of about 30 mm which corresponds to 0.6 percent. The unsupported span of 5 metres of this embodiment of the invention compares to a span of up to 3 metres for conventional decking without a longitudinal precamber.

As shown in Figure 1 the web 16 of the metal decking member 12 is also pre-cambered in transverse sectional

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profile inwardly. The transverse pre-camber of the web 16 in this example is approximately 2% measured as the maximum offset of the web 16 from a substantially flat plane and expressed as a percentage relative to the width of the web 16. In this example the metal decking member 12 has a width of approximately 300 mm and is roll formed from sheet metal of a thickness of about 1.2 mm.

The flanges 18 and 20 include respective longitudinally extending ribs 30 and 32. The ribs 30 and 32 are roll formed in the lower portion of the respective flange 18 and 20 adjacent the web 16. One of the ribs 30 is formed as an inwardly directed protrusion whereas the other rib 32 is shaped complementary to the opposite rib 30 but directed outwardly of the decking member 12. The longitudinal ribs 30 and 32 are aligned so that adjacent ribs such as 32 and 34 of adjacent decking members 12 and 14 can nest within one another. Thus, nested ribs such as 32 and 34 inhibit vertical movement of the deck members 12 and 14 relative to one another and assists in alignment of the adjacent deck members 12 and 14.

The longitudinal precamber in the web 16 of the metal decking member 12 is formed by corrugating the web 16. The corrugations (not shown) are oriented transverse and extend partly across the width of the web 16. The transverse corrugations are cold roll formed in the web 16 are sufficiently "light" to provide the preferred longitudinal precamber of up to about 2%. The corrugations may be formed either in the flat strip or in the web 16 once it is formed into the C-section profile. Otherwise, corrugation of the web 16 is performed via corrugating

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rolls (not shown) in a conventional cold roll forming manner.

Adjacent metal decking members 12 and 14 of this
5 embodiment are secured together via a series of fasteners
in the form of screws such as 36 which engage abutting or
adjacent flange such as 18 and 20 of adjacent decking
members 12 and 14. The fasteners such as 36 are spaced
longitudinally along the decking members such as 12 and
10 14. Figure 3 illustrates an alternative form of fixing
means for securing adjacent flanges of adjacent decking
members together. The fixing means is in this alternative
example in the form of a resilient clip 38 which
releasably engages adjacent free edge portions such as 22
15 and 24 of adjacent decking members 12 and 14 respectively.
The resilient clip 38 is used as substitute for the
fastenings such as the screw 36. The resilient clip 38 is
of a similar profile to the free edge portions 22 and 24
arranged back to back and is configured so that it is
20 biased inwardly to force the adjacent flanges 18 and 20
together. The resilient clip 38 is thus in profile
generally C-shaped with its free edge portions flared
outwardly for ease of clipping or mounting about the free
edge portions 22 and 24 of the adjacent flange 18 and 20
25 respectively.

Conventional metal decking members are generally of
an asymmetric configuration wherein opposing flanges are
turned inward and outward respectively. Thus, the
30 conventional metal decking is formed by overlapping
adjacent flanges. The tendency for conventional metal
decking is to fail under load wherein the adjacent
overlapping flanges collapse or rotate toward the web of

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one of the decking members. It is understood that the abutting flanges of adjacent metal decking members of this embodiment of the invention are less vulnerable to failure in this manner.

5

Those skilled in the art will appreciate that the invention described herein is susceptible to variations and modifications other than those specifically described. For example, the C-section profile of the decking members may vary provided the metal decking member is
10 longitudinally and/or transversely pre-cambered inwardly of the metal decking. The metal decking member in an alternative embodiment may be of the type commercially available in Australia under the trade mark BONDEK having
15 one or more upstanding and longitudinally extending ribs. In this embodiment the web together with the upstanding ribs are precambered inwardly of the metal decking member. All such variations and modifications are to be considered within the scope of the present invention the nature of
20 which is to be determined from the foregoing description.

In the preceding summary of the invention, except where the context requires otherwise due to express language or necessary implication, the word "comprising"
25 is used in the sense of "including", that is the features specified may be associated with further features in various embodiments of the invention.

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THE CLAIMS:

1. A metal decking member being elongate and of a C-section profile including a web and a pair of opposing
5 flanges, the web being longitudinally precambered inwardly of the metal decking member
2. A metal decking member as defined in claim 1 wherein the web together with the opposing flanges are
10 longitudinally precambered.
3. A metal decking member as defined in claim 1 or 2 also including transverse corrugations cold roll formed in the web.
15
4. A metal decking member as defined in claim 3 wherein the transverse corrugations are relatively light.
5. A metal decking member as defined in any one of the
20 preceding claims wherein the longitudinal precamber is up to about 2% measured as the maximum longitudinal offset of the web from a substantially flat plane and expressed as a percentage relative to the length of the web.
- 25 6. A metal decking member as defined in claim 5 wherein the longitudinal precamber is between about 0.4% to 1%.
7. A metal decking member as defined in any one of the preceding claims wherein the web in transverse section is
30 precambered inwardly of the metal decking member.
8. A metal decking member as defined in claim 7 wherein the transverse pre-camber is up to about 5% measured as

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the maximum offset of the web from a substantially flat plane and expressed as a percentage relative to the width of the web.

5 9. A metal decking member as defined in claim 7 wherein the transverse pre-camber is between about 1% to 4%.

10. A metal decking member being elongate and of a C-section profile including a web and a pair of opposing
10 flanges, the web in transverse section being pre-cambered inwardly of the metal decking.

11. A metal decking member as defined in claim 10 wherein the transverse pre-camber is up to about 5% measured as
15 the maximum offset of the web from a substantially flat plane and expressed as a percentage relative to the width of the web.

12. A metal decking member as defined in claim 10 wherein
20 the transverse pre-camber is between about 1% to 4%.

13. A metal decking member as defined in any one of the preceding claims wherein the pair of opposing flanges are disposed symmetrically either side of an imaginary
25 longitudinal axis of the metal decking member.

14. A metal decking member as defined in claim 13 wherein the C-section profile of the metal decking member is substantially symmetrical.

30 15. A metal decking member as defined in any one of the preceding claims wherein a free edge portion of the C-

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section metal decking member includes a lip return disposed parallel to the corresponding flanges.

16. A metal decking member as defined in any one of the
5 preceding claims wherein the flanges each include a longitudinally extending rib.

17. A metal decking member as defined in claim 16 wherein
10 the ribs are shaped complementary to and aligned with one another, one of the ribs protruding outwardly and the other of said ribs protruding inwardly whereby adjacent ribs of adjacent decking members nest within one another.

18. A metal decking member as defined in any one of the
15 preceding claims wherein said member is one of a plurality of metal decking members arranged alongside one another to together form metal decking.

19. A metal decking member as defined in claim 18 wherein
20 adjacent of the plurality of decking members are secured together via fixing means.

20. A metal decking member as defined in claim 19 wherein
25 said fixing means includes one or more fasteners designed to engage adjacent flanges of adjacent decking members.

21. A metal decking member as defined in claim 19 wherein
30 said fixing means includes a resilient clip configured to releasably engage free edge portions of adjacent flanges of adjacent decking members.

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22. A metal decking member as defined in any one of claims 18 to 21 wherein the plurality of decking members are clad or embedded in a concrete slab.

5 23. A method of forming a metal decking member being elongate and of a C-section profile including a web and a pair of opposing flanges, said method involving roll forming transversely oriented corrugations in at least part of the web whereby the web is longitudinally
10 precambered inwardly of the metal decking member.

24. A method of forming a metal decking member as defined in claim 23 wherein the transverse corrugations are cold roll formed in the web.

15

25. A method of forming a metal decking member as defined in claim 3 wherein the transverse corrugations are relatively light.

20 26. A method of forming a metal decking member in any one of claims 23 to 25 wherein the metal decking member is cold roll formed.

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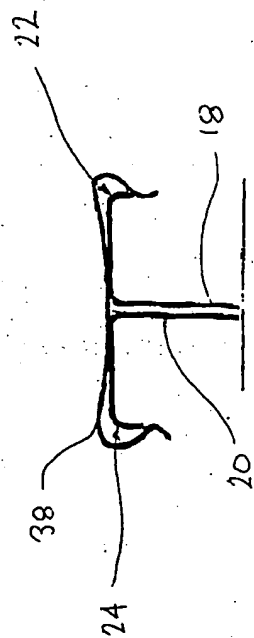


FIG. 3

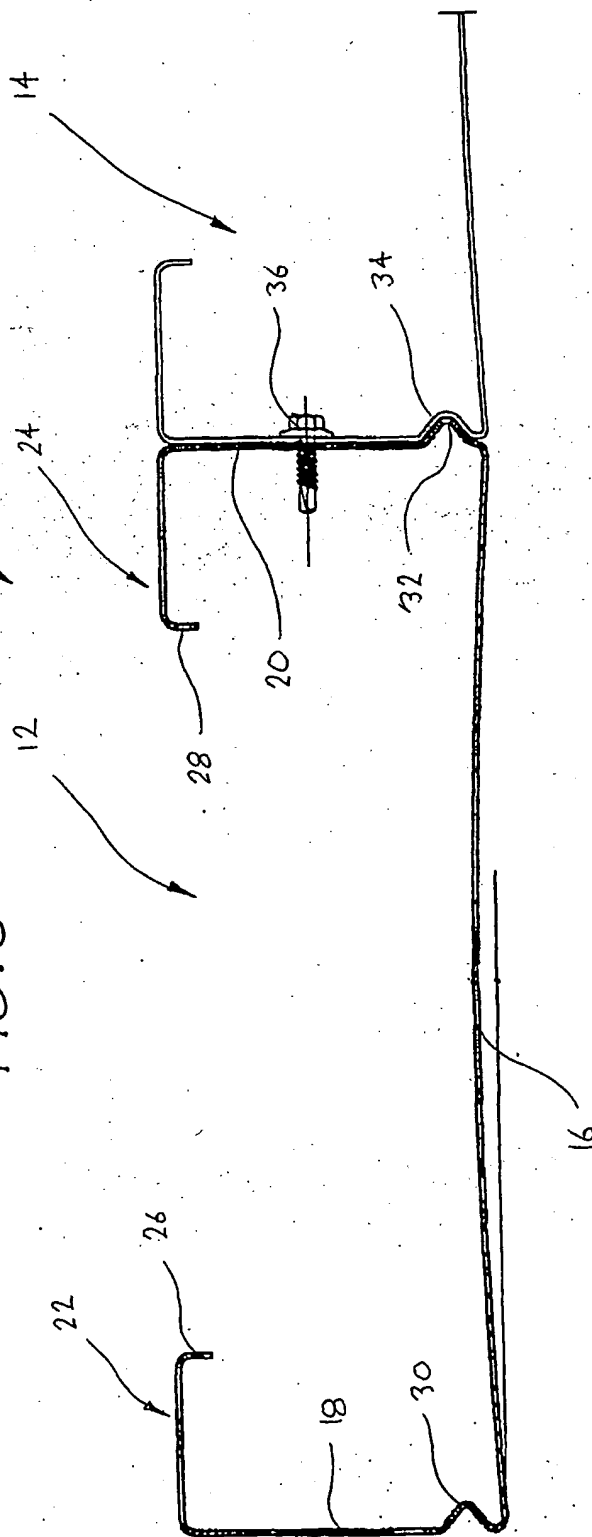


FIG. 1

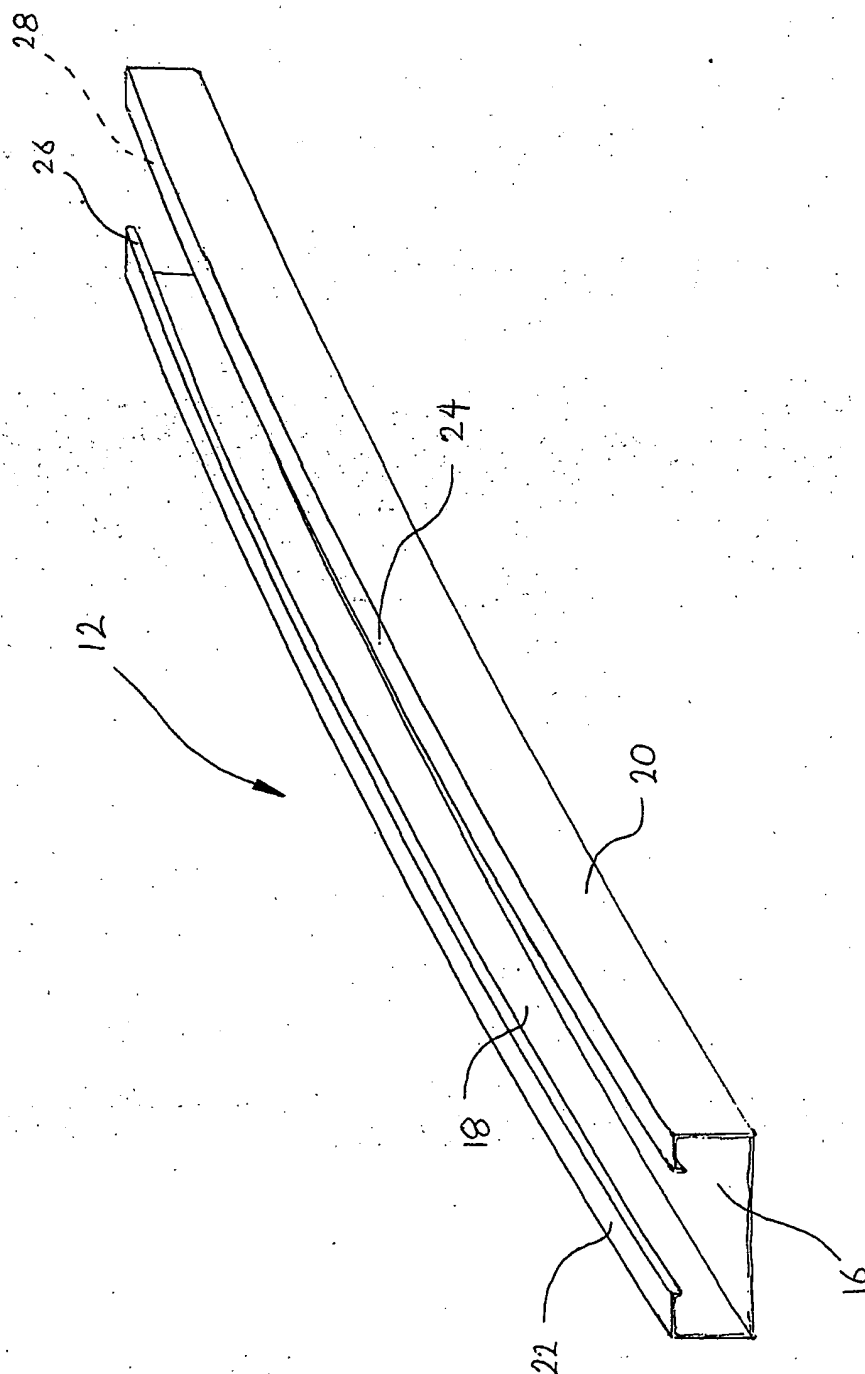


FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU01/01447

A. CLASSIFICATION OF SUBJECT MATTER		
Int. Cl. ⁷ : E04C 2/08 E04B 5/40, E04D 3/30		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols)		
IPC CAPRI: E04C 2/08, 2/30, 2/32, E04B 5/40, E04D 3/30; refer Electronic data base consulted		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
DWPI JAPIO IPC E04B E04C E04D E04G and Keywords (panel, sheet, board, lining, galvanise, camber, precamber, bow, bend, bent, arc, convex, concave, curve, roof, floor, deck, metal, aluminum, steel, clad, interlock, mate, snap, web, flange, rib) and like terms		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2000129847 A (SUMITOMO METAL STEEL PRODUCTS INC) 9 May 2000	1-9, 23-26
A	US 4424652 A (TURNER) 10 January 1984	1-9, 23-26
X	EP 606146 B (HUNTER DOUGLAS INDUSTRIES B.V.) 13 July 1994	10-15
Y	drawings	13-22
X	AU 53050/59 B (237706) (CHARLES SMITH) 24 March 1960	10-15
Y	drawings	13-22
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C <input checked="" type="checkbox"/> See patent family annex		
<p>* Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&" document member of the same patent family</p>		
Date of the actual completion of the international search		Date of mailing of the international search report
3 January 2002		10 JAN 2002
Name and mailing address of the ISA/AU		Authorized officer
AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustalia.gov.au Facsimile No. (02) 6285 3929		JAGDISH BOKIL Telephone No : (02) 6283 2371

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU01/01447

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 9740243 A (BHP STEEL [JLA] PTY LTD) 30 October 1997 whole document	13-22
Y	FR 2641812 A (PROFILAFROID SA - FR) 20 July 1990 see drawings	13-21
Y	US 5586418 A (ALANDER et al) 24 December 1996 see drawings	13-15, 22
Y	US 3462906 A (SCHROYER) 26 August 1969 see drawings	16-21
Y	WO 00/63504 A (DAMPA A/S et al) 26 October 2000 page 5 lines 30-32	16-21
A	US 3902288 A (KNUDSON) 2 September 1975 figure 4	
P, A	JP 2001152674 A (REITO KK) 5 June 2001 figure 6	
O	"The Standard Mill Shapes Rolled", Roltech Industries Inc [online], [retrieved from the Internet on 2002-01-03 <URL: http://www.roltech.com/rolled.htm >] see shape type 8	1-9, 23-26
	For the purposes of assessing the inventive step, any one of the citations 5-9 may be combined with any one of citations 3-4, with relevance to claims as indicated.	

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU01/01447

Box I Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos :
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos :
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos :
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box II Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

SEE EXTRA SHEET

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims
2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU01/01447

Supplemental Box

(To be used when the space in any of Boxes I to VIII is not sufficient)

Continuation of Box No: II

The international application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept. The International Searching Authority has found that there are different inventions as follows:

1. Claims 1-9, 23 - 26 (and other claims dependent on claims 1-9) are directed to a metal decking member of c-section profile including a web and a pair of flanges, the web being *longitudinally* precambered inwardly of the decking member. It is considered that the web being longitudinally precambered inwardly of the decking member comprises a first "special technical feature".
2. Claims 10-12 (and other claims dependent on claims 10-12) are directed to a metal decking member of c-section profile including a web and a pair of flanges, the web being *transversely* precambered inwardly of the decking member. It is considered that the web being transversely precambered inwardly of the decking member comprises a second "special technical feature".

Since the abovementioned groups of claims do not share any of the technical features identified and a C sectioned metal profile with camber in cross section is known (see eg the third citation in this international search report), a "technical relationship" between the inventions, as defined in PCT rule 13.2 does not exist. Accordingly the international application does not relate to one invention or to a single inventive concept, *a priori*.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/AU01/01447

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report			Patent Family Member				
JP	2000129847	NONE					
US	4424652	AU	77044/81	NZ	198744		
EP	606146	AU	53014/94	BR	9400031	CN	1094777
		JP	6341193	SG	48699	US	5475962
WO	9740243	AU	25617/97	CN	1218530		
FR	2641812	NONE					
US	5586418	WO	9401636	AU	45024/93	PL	306852
WO	200063504	AU	200041002	DK	521/99		
US	3902288	AU	51855/73	CA	985869	CA	997917
		DE	2305620	DE	2365729	FR	2172250
		GB	1418407	US	3842647	US	3967430
JP	2001152674	NONE					
END OF ANNEX							